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# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

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### **Paper No. 1: Can U.S. Shipbuilders Become Competitive in the International Merchant Market?**

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# THE NATIONAL SHIPBUILDING RESEARCH PROGRAM'S 1990 SHIP PRODUCTION SYMPOSIUM

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THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS  
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## Shipyard Skills-Tracking System

3B-1

John Walker Hartigan, NAVSEA, Washington, DC

*The naval shipyards are in the process of installing a system for identifying and recording specific job-related skills in their industrial workforce. The system, called the Shipyard Skills Tracking System (SSTS), is intended initially to support middle-level management in allocating their workforce properly for critical tasks and in accurately factoring personnel availability and training requirements into the planning for upcoming work. SSTS is supported by sophisticated computer programs which are integrated into other shipyard administrative programs. Data entry, ever the bugaboo of large scale tracking programs, is minimized by using data links to other job related programs for most of the information. The programs have been successfully field-tested at one naval shipyard and, starting in November 1989, began undergoing phased installation at all eight government yards.*

You are a newly-appointed general foreman in the pipe shop at the (mythical) San Jose Naval Shipyard. Having arrived at NAVSHIPYD SJOE only two weeks ago, you are not yet fully familiar with the capabilities and qualifications of the personnel in your shop.

You answer the phone. It is the head of a NAVSHIPYD SJOE "tiger team" that is performing repairs on a submarine in Heavy Loch, Scotland.

"You gotta help me! We need a pipefitter over here right away! We need somebody who can do a battery replacement, and it's got to be someone who can take the lead on the job."

Who can you send? Which of several hundred people in the shop has the necessary skills and experience to do the job? You remember overhearing someone in the shop mention that Jim Smith had worked a battery replacement job. But how long ago did he do it? And how good is he? Is he capable of serving as the lead mechanic on the job at Heavy Loch?

There are additional questions you need answers to, and not much time to get them. Is Jim Smith available to go to Heavy Loch for three weeks or more? To be sent immediately, he will need a passport: does he have one? Is it current? What formal qualifications are needed to perform a submarine battery replacement? Are Jim Smith's quali-

fications current, or have they **expired**, and, if they have, which ones will require that he be retrained and which that he be re-tested without additional training? And, perhaps the most important questions: is Jim Smith the best mechanic to send on this job? or are there others in the shop who are equally or better qualified?

Supervisors and managers in the naval shipyards now have a system that can answer all of these questions and more: the Shipyard Skills-Tracking System (SSTS). Today, using SSTS, you, as the general foreman with the battery-replacement problem, simply turn to the microcomputer on your desk and request a list of all mechanics in your shop who have accomplished a battery replacement successfully. In a few seconds, the computer displays a list of those mechanics, including how many times each of them performed the job, how significant their contribution was to its completion, and how recently they performed it. Based on this information, you are quickly able to identify those mechanics who are most skilled at battery replacement and to assign one to the job.

Generations of foremen and general foremen in the naval shipyards have dealt with such questions by simply remembering, as best they could, who in their work gangs and shops possessed special skills and experience. Often they kept informal records in hip-pocket booklets. But today's ships are too complex for that to be feasible any longer. Much of the work on nuclear submarines and surface ships with sophisticated combat systems requires that the mechanics assigned possess formal qualifications for performing it--too much of the work and too many qualifications for any manager to keep in his or her head. And many shipboard systems are too sensitive to error to risk assigning mechanics who are not fully competent to perform the required work correctly--the consequences of error can be expensive rework or harm to the ship or its personnel.

In recent years, many shipyard production shops have tried to systematize the collection and maintenance of data on the special qualifications and skills of their personnel. The results of such efforts were known variously as "skills banks" and "skills inventories." Some shops were successful in the initial establishment of their banks or inventories, only to find themselves unable to keep them current

as their workers acquired new skills, lost skills through disuse, transferred, and retired. But, as was stated in 1988 by Dr. Amiel T. Sharon, "The increasing complexity and sophistication of industrial equipment, processes and systems creates a demand for specialized maintenance skills that require extensive training and experience. Consequently, to use its personnel effectively, an organization must have up-to-date information on its individual employees' capabilities"(1).

At a conference in 1985, the Naval Sea Systems Command (NAVSEA)'s Training Information Resources Office (TIRO) stepped into the breach. Representatives of seven of the eight naval shipyards asked NAVSEA to develop a skills-tracking system that could be used by the production shops in all yards: TIRO was assigned to develop the basic specifications for such a system and to manage its development and implementation.

TIRO's design of what has become the Shipyard Skills-Tracking System (SSTS) benefitted from an advantage not enjoyed by previous generations of skills-bank designers: the advent of the microcomputer, and the ability that microcomputer technology affords for keeping data reliably current.

SSTS is an on-line automated data-processing system that identifies those workers who are experienced and qualified to perform critical, complex, difficult, and hazardous tasks. SSTS accomplishes this by tracking workers' nuclear, radiological-control (RadCon), and submarine-safety (SubSafe) qualifications and any other skills and qualifications they possess that a shop chooses to track. SSTS also monitors employee training records and shop work experience. The system provides supervisors and managers with immediate and current data on workers' qualifications and requalification status, enabling them to assign the qualified personnel with the best experience to complex and critical jobs.

SSTS is an Integrated Data Store II (IDS-II) database system that is accessed through Transaction Processor 8 (TP8), COBOL-74 transaction-processing routines (TPRs), and 3270-protocol communications. SSTS resides on a naval shipyard's Honeywell mainframe computer. The system can be accessed from any terminal or microcomputer that can communicate via 3270 protocol with the Honeywell mainframe. This feature permits a shipyard supervisor or manager to use SSTS to check workers' skills and qualifications, to input time and attendance data via the Automated Time and Attendance Muster System (ATAMS), and to check on the status of work materials through the Material Management (MM) system, all from the same terminal or microcomputer.

An important feature of SSTS is that it runs on existing computer hardware --no new equipment had to be bought on which to run SSTS.

The currency of data in SSTS is maintained through interfaces with other shipyard standard and local mainframe, mini-, and microcomputer systems, such as the Shipyard Management Information System (SYMIS) payroll application and the Automated Radiological Control Management information System (ARCMIS).

The supervisor or manager using SSTS gains access to the data he or she needs via a series of screen menus that guide him or her to the desired report screen. Some of the information available on these report screens includes:

- Requalification dates (see figures 1 and 2). This report is produced in date sequence and can be provided on all workers in the entire shipyard, on an individual shop's workers, on workers assigned to a specific supervisor, on an individual worker, or on an individual qualification.
- The qualifications needed by a worker to perform a particular job (see figures 3 and 4). Qualification requirements are defined at the job, duty, task, and subtask levels.
- A list of the names of all workers experienced in application of a particular skill. This report can be provided to identify all workers with the skill in the entire shipyard or only those in a specific shop or trade (see figures 5 and 6), or only those assigned to a particular supervisor, or only those who possess a specific attribute, such as a current passport or willingness to work at remote job sites (see figures 7 and 8). Figure 9 displays the screen report of all of the attributes that one of the naval shipyards has chosen to track and on which SSTS will provide information.
- Skills possessed by a specific worker (see figures 10 and 11).
- An individual worker's attributes (see figures 12 and 13).
- Secondary skills. These are skills a shipyard may want to call on a worker to employ when workload is temporarily light in the worker's trade. SSTS provides reports of the secondary skills currently being tracked by a shipyard, of all employees who possess a specific secondary skill (by supervisor, by shop, or for the entire yard), and of the secondary skills possessed by a specific worker (see figures 14 and 15).

SKILLS TRACKING SYSTEM  
MENU FOR REQUALIFICATION DATES

ENTER SHOP: \*\*

ENTER PARAMETER DATE: 06/01/92 (MM/DD/YY)

ENTER SUPERVISOR CODE: 43  
(IF DESIRED)

ENTER QUALIFICATION: AIR-FED RESPIRATOR\*\*\*\*\*  
(IF DESIRED)

THE PARAMETER ENTRY LIMITS THE REPORT SCREEN TO  
REQUALIFICATIONS NEEDED PRIOR TO THAT DATE

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO QUERIES MENU:

---

Figure 1. MENU FOR REQUALIFICATION DATES

---

SKILLS TRACKING SYSTEM  
REPORT OF REQUALIFICATION DATES

SHOP: 56	BADGE	PAY	SHIFT			REQUAL
EMPLOYEE NAME	NUMBER	GRADE	SUPER	QUALIFICATION		DATE
JOHNSON, C,	238749	WG-10	1 43	AIR-FED RESPIRATOR		01/15/91
MAXWELL, S.	312647	WG-05	1 43	AIR-FED RESPIRATOR		03/23/91
FELLOWS, E.	265439	KG-05	1 43	AIR-FED RESPIRATOR		03/10/91
ADAMS, L.	135243	NG-10	1 43	AIR-FED PESPIRATOR		03/10/92

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 2. REPORT OF REQUALIFICATION DATES

---

SKILLS TRACKING SYSTEM  
MENU FOR QUALIFICATIONS NEEDED TO PERFORM A SPECIFIC SKILL

ENTER SKILL SHOP: 56

AND

ENTER SKILL CODE: 0B0105

OR SKILL DESCRIPTION: \*\*\*\*\*

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO QUERIES MENU:

---

Figure 3. MENU FOR QUALIFICATIONS NEEDED TO PERFORM A SPECIFIC SKILL

---

SKILLS TRACKING SYSTEM  
REPORT OF QUALIFICATIONS NEEDED TO PERFORM A SPECIFIC SKILL

SKILL SHOP: 56      SKILL CODE: 0B0105      SKILL TYPE: OT

SKILL DESCRIPTION: BATTERY REPLACEMENT

QUALIFICATIONS: BATTERY SAFETY  
RESPIRATOR

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 4. REPORT OF QUALIFICATIONS NEEDED TO PERFORM A SPECIFIC SKILL

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                SKILLS TRACKING SYSTEM
            MENU FOR EMPLOYEES EXPERIENCED AT A SPECIFIC SKILL

ENTER SKILL SHOP:      56
AND
ENTER SKILL CODE:      *****
OR SKILL DESCRIPTION:  BATTERY REPLACEMENT*****

ENTER SUPERVISOR CODE: **
                        (IF DESIRED)

ENTER OCCUPATION CODE: ****
                        (IF DESIRED)

ENTER UNIQUE ATTRIBUTE: *****
                        (IF DESIRED)

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO QUERIES MENU:

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---

Figure 5. MENU FOR EMPLOYEES EXPERIENCED AT A SPECIFIC SKILL

---

```

                SKILLS TRACKING SYSTEM
            REPORT OF SHOP EMPLOYEES EXPERIENCED AT A SPECIFIC SKILL

SKILL SHOP:56          SKILL CODE: 0B0105          SKILL DESCRIPTION:BATTERY REPLACEMENT
SKILL TYPE:OT          UNIQUE ATTRIBUTE:  NOT REQUESTED

      BADGE          PAY          SHIFT          SKL  TIMES  DATE LAST
EMPLOYEE  NUMBER TRADE    SHOP GRADE    SUPER  QUAL  LEV  PERFMD  COMPLETED
ADAMS,L.  135243  PIPEFITTER  56    WG-10    1  43  RS    1    007    05/10/88
FOX, J.   247431  PIPEFITTER  56    WG-05    1  23    5    001    05/10/88
OLSEN,D.  354352  PIPEFITTER  56    WG-08    2  29  S    2    005    11/15/89
SMITH,J.  786503  PIPEFITTER  56    WG-10    1  43  NRS   1    004    11/15/89

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

```

---

Figure 6. REPORT OF SHOP EMPLOYEES EXPERIENCED AT A SPECIFIC SKILL

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                SKILLS TRACKING SYSTEM
            MENU FOR EMPLOYEES BY UNIQUE ATTRIBUTE

ENTER UNIQUE  ATTRIBUTE:      SAN DIEGO *****k*

ENTER SHOP OR "XX":      xx

ENTER SUPERVISOR CODE: **
                        (IF DESIRED)

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO REPORT MENU:

```

---

Figure 7. MENU FOR EMPLOYEES BY UNIQUE ATTRIBUTE

---



SKILLS TRACKING SYSTEM  
REPORT OF EMPLOYEES BY UNIQUE ATTRIBUTE

UNIQUE ATTRIBUTE:            SAN DIEGO

EMPLOYEE	BADGE NAME	NUMBER	SHOP	PAY GRADE	SUPERVISORS NAME
ADAMS, L.	135243	PIPEFITTER	56	WG-10	JONES, J.
FOX, J.	247431	PIPEFITTER	56	WG-05	SIMMONS, R.
OLSEN, D.	354352	PIPEFITTER	56	WG-08	HANKS, A.
SMITH, J.	786503	PIPEFITTER	56	WG-10	JONES, J

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 8 REPORT OF EMPLOYEES BY UNIQUE ATTRIBUTE

---

SKILLS TRACKING SYSTEM  
REPORT *OF* CURRENT ATTRIBUTES

PASSPORT  
ALAMEDA  
HUNTERS POINT  
SAN DIEGO  
GROTON, CT  
OTHER USA LOATIONS  
ROTA, SPAIN  
OTHER OVERSEAS LOCATIONS  
SEA TRIALS (SSN637)  
SEA TRIALS (SSN688)  
O. E. CLEARENCE  
STE  
FORK LIFT LICENSE  
EMERGENCY RESPONSE TEAM

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 9. REPORT OF CURRENT ATTRIBUTES

---

SKILLS TRACKING SYSTEM  
MENU FOR SKILLS PERFORMED BY A SPECIFIC EMPLOYEE

ENTER EMPLOYEE BADGE NUMBER:        \*\*\*\*\*  
OR  
ENTER EMPLOYEE FIRST INITIAL:        \*  
EMPLOYEE LASTNAME:        \*\*\*\*\*

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO QUERIES MENU:

---

Figure 10. MENU FOR SKILLS PERFORMED BY A SPECIFIC EMPLOYEE

---

SKILLS TRACKING SYSTEM  
REPORT OF SKILLS PERFORMED BY A SPECIFIC EMPLOYEE

EMP. NAME: SMITH, J.	BADGE: 786503	TRADE: PIPEFITTER
SUP. NAME: JONES, J.	PAY GRADE: WG-18	SHOP: 56 SHIFT: 1
NUCLEAR LEVEL: LIMITED	RADCON LEVEL: BASIC	SUBSAFEQUAL: YES
REQUAL. DATE: 01/15/91	REQUAL. DATE: 12/21/98	REQUAL. DATE: 10/14/90

LISTING OF SKILLS PERFORMED

SKILL SHOP	SKILL CODE	SKILL DESCRIPTION	TYPE	LEVEL	TIMES PERFD	DATE LAST COMPLETED
56	0A0107	ASW SYSTEM PIPING FLANGES	SS	1	006	12/19/88
56	0B0105	BATTERY REPLACEMENT	OT	2	004	11/15/89
56	0C1204	BUTTWELD JOINT MAKEUP	NU	1	024	07/20/89
56	0C1609	H.P. AIR SYSTEM VALVES	SS	1	024	08/18/89
56	0D0304	TRIM DRAIN FLANGES	SS	2	010	09/05/87
56	060903	DISTILLERS 2K-8K-16K GPD	OT	3	001	05/18/86
56	050204	FLEXATALILC FLANGE MAKEUP	SS	2	004	02/22/90
56	0L1002	FREEZE SEAL	NU	1	007	02/22/90
56	0M0304	RESIN FILL BEND	NU	1	006	06/21/89
56	0N1103	SILVER BRAZE (NUCLEAR)	NU	1	024	04/14/88
56	0W201	WAVE GUIDE (FABRICATE)	OT	3	001	05/09/86
56	0W0301	WAVE GUIDE (INSTALL)	OT	3	001	06/03/86

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 11. REPORT OF SKILLS PERFORMED BY A SPECIFIC EMPLOYEE

---

SKILLS TRACKING SYSTEM  
MENU FOR UNIQUE ATTRIBUTES BY A SPECIFIC EMPLOYEE

ENTER EMPLOYEE BADGE NUMBER: 786503  
OR  
ENTER EMPLOYEE FIRST INITIAL: \*  
EMPLOYEE LAST NAME: \*\*\*\*\*

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 12. MENU FOR UNIQUE ATTRIBUTES BY A SPECIFIC EMPLOYEE

---

SKILLS TRACKING SYSTEM  
REPORT OF UNIQUE ATTRIBUTES BY EMPLOYEE

EMP. NAME: SMITH, J.	BADGE: 786503	TRADE: PIPEFITTER
SUP. NAME: JONES, J.	PAY GRADE: WG-10	SHOP: 56 SHIFT: 1
NUCLEAR LEVEL: LIMITED	RADCON LEVEL: BASIC	SUBSAFE QUAL: YES
REQUAL. DATE.: 81/15/91	REQUAL. DATE: 12/21/90	REQUAL. DATE: 10/14/90

LISTING OF UNIQUE ATTRIBUTES

PASSPORT  
HUNTERS POINT  
SAN DIEGO  
FORK LIFT LICENSE  
O.E. CLEARENCE

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

---

Figure 13. REPORT OF UNIQUE ATTRIBUTES BY EMPLOYEE

---

```

                SKILLS TRACKING SYSTEM
            MENU FOR SECONDARY SKILLS BY A SPECIFIC EMPLOYEE

ENTER EMPLOYEE BADGE NUMBER:      786503
OR
ENTER EMPLOYEE FIRST INITIAL:      *
EMPLOYEE LAST NAME:      *****

PRESS ENTER TO PROCESS TRANSACTION OR ENTER AN "X" TO EXIT TO REPORT MENU:

```

---

Figure 14. MENU FOR SECONDARY SKILLS BY A SPECIFIC EMPLOYEE

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                SKILLS TRACKING SYSTEM
            REPORT OF SECONDARY SKILLS BY EMPLOYEE

EMP. NAME: SMITH, J.      BADGE: 786503      TRADE: PIPEFITTER
SUP. NAME: JONES, J.      PAY GRADE: WG-10     SHOP: 56 SHIFT: 1
NUCLEAR LEVEL: LIMITED    RADCON LEVEL: BASIC    SUBSAFE QUAL: YES
REQUAL. DATE: 81/15/91    REQUAL. DATE: 12/21/90    REQUAL. DATE: 10/14/90

                LISTING OF SECONDARY SKILLS

AUTOMOTIVE TUNE-UP
PAINTING
SANDBLASTING
WELDING (NON-PRODUCTION)

PRESS ENTER TO DISPLAY NEXT PAGE OR ENTER AN "X" TO EXIT TO REPORT MENU:

```

---

Figure 15. REPORT OF SECONDARY SKILLS BY EMPLOYEE

---

In addition to the foregoing, SSTS provides reports on the workers who possess a specific attribute, on the qualifications that a yard is currently tracking, and on the skills currently being tracked by the yard. SSTS also provides reports on the number of employees, by pay grade, who possess skills being tracked by the system; reports on supervisors to whom personnel who possess tracked skills are assigned; and a report on the numbers of workers possessing tracked skills who are eligible to retire. This last report is by shop and projects retirement eligibility for the *next five years*.

SSTS was implemented between April 1989 and July 1990, and is now on line and in use in six of the eight naval shipyards. The system may be implemented at the Long Beach Naval Shipyard at some future date, but, because of workload and staffing considerations at that yard, there are no current plans to do so. Full implementation of the system at Mare Island is awaiting on resolution of some computer software incompatibilities.

Not only does SSTS show how often and how recently a worker has performed a given job, it also indicates at what level the worker has performed it. Upon completion of a job, the supervisor indicates on the worker's time card (or equivalent record, where time cards are not employed), whether the worker performed at the "5" level (meaning the worker provided some assistance to a lead mechanic) or at the

"1" level (meaning that the Worker performed the job independently or was its lead mechanic), or at a level between those extremes. The skill-level indication is not a performance rating but, rather, a guide for the supervisor and manager to use in making work assignments and in determining training requirements.

Determination of training requirements is one of the ways SSTS can be put to use beyond the shop floor. SSTS provides a tool for shipyard management to use in comparing projected workload with skills on hand. SST's reports can reveal skill shortfalls and point up where new training, hiring, or other workforce adjustments are needed to bring a shipyards skill mix in line with its workload requirements.

It should be emphasized, though, that SSTS is neither a training-management system nor a record of training undergone by workers. Training records indicate what training workers have received, but they do not necessarily show what work those workers are capable of doing. Unless a particular training course has included a requirement that its trainees demonstrate their mastery of specific job skills, it cannot be assumed that the course imparts the skills necessary to do the required work. Moreover, most work skills are learned on the job, not in the classroom, and so never appear in the training records. SSTS, however, documents skills that have actually been demonstrated on the job.

Because SSTS has been designed and programmed to run on the naval shipyards Honeywell computers, and because the system is dependent on interfaces with other naval-shipyard automated data processing programs, it cannot be exported to a private shipyard or other industrial enterprise and used as is. Two SSTS documents, the *System Files Update Users' Manual* (2) and the *System Files Queries Users' Manual* (3) could, however, be used as a guide to the architecture of the system by those interested in designing and programming their own skills-tracking systems.

#### **Note**

The names of workers and supervisors in the figures accompanying this paper are fictional, so that no privacy-act requirements have been violated; neither have any classified or "NOFORN" data been included.

#### **Acknowledgments**

*The success of SSTS in getting off the drawing board and into the hands of shipyard users is due in large part to the energy and tenacity of Donald E. Cummings, Director of the NAVSEA Training Information Resources Office, who, as SSTS project*

*manager, spearheaded its design and implementation. Programming, testing, and loading of SSTS were capably managed by Donald Wamsley and Stephen Clements of the NAVSEA Automated Data Systems Activity (SEAADSA).*

*The author was assisted in preparation of this paper by Lcdr C. Lee Walker USN (Ret).*

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